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SHIELD PHASE II TRANSFERS SUCCESSFUL LEGACY FOR NATIONAL MISSILE DEFENSE APPLICATIONS

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The Opinions Expressed In This Paper Are Solely Those Of The Authors, And Do Not Represent The Official Position Of The United States Government, Or Its Agencies. Due To The Classified Nature Of This Subject , Many Performance Details Concerning SHIELD Are Not Included. Details May Be Obtained From The Shield Project Manager, Maj Christopher J, Fraser Via The Space Warfare Center, Falcon AFB Colorado.

I. EXECUTIVE OVERVIEW

The purpose of this paper is to identify how the successful legacy of the SHIELD project is being directly applied to the development and transition to operations of an emergency response system for National Missile Defense (NMD) Battle Management, Command, Control, and Communications (BMC3), and how existing elements and infrastructures are being optimized to provide a functional, capable system in the near-term for use in the execution of NMD.

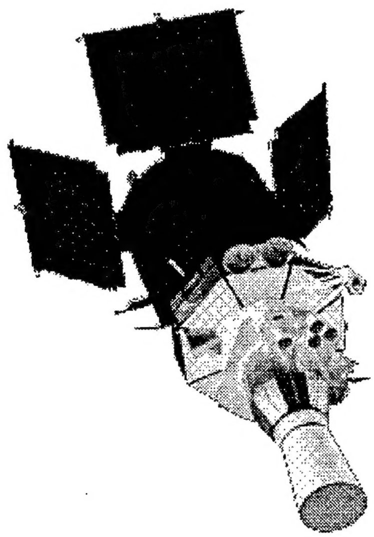
Most NMD functions are not unique to the Air Force nor to Air Force Space Command (AFSPC). Surveillance and warning, event detection, threat assessment, and attack characterization all currently exist in AF support architectures for theater and ITW/AA infrastructures. In addition, the AF MMIII has been shown to be an accurate and effective weapon which can be of significant use during the reapportionment of existing strategic resources for defensive purposes.

Data to support these functions readily flows across current operational and developmental systems in a variety of AFSPC centers. For emergency response and contingency operations, a large measure of the existing capabilities and information flow can be exploited. Development work for NMD-unique functions is minimal and integration to existing command and control infrastructures is neither complex nor time intensive.

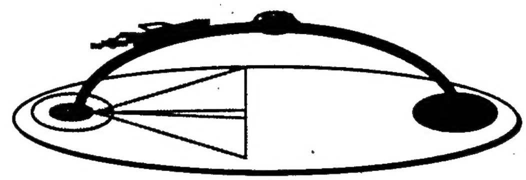
Taking advantage of methodologies used in the development and transition of TALON SHIELD to the operational 11th Space Warning Squadron (SWS), we will illustrate how these successful techniques can be used once again by leveraging existing AF systems to maximize interoperability of sensors, minimize technical risk, minimize start-up and transition times, and use revolutionary acquisition, testing, and normalization structures to produce a more timely, cost effective NMD BMC3 architecture, and a "Global SHIELD" against threats from around the world.

II. BACKGROUND: THE TALON SHIELD LEGACY

The Space Warfare Center's SHIELD development began in July 1992 as a BMDO funded AF TENCAP initiative, TALON SHIELD. This development was highly successful in restructuring existing paradigms in acquisition and operational systems development, and resulted in the first ever BMDO program to achieve operational status. TALON SHIELD transitioned to the world's most capable early warning system, the Attack and Launch Early Reporting to Theater (ALERT) system of AFSPC's 11th Space Warning Squadron (SWS) after less than 32 months and a total expenditure of less than $50 million.



TALON SHIELD's initial charter was to determine through design, demonstration, development and delivery what improvements could be gained for Theater Missile Defense (TMD) by exploiting existing technologies in more productive ways. Defense Support Program (DSP) missile warning satellites were used during Desert Storm, but deficiencies were identified that showed the satellites had greater potential for supporting theater conflicts than what their processing systems were designed to handle. TALON SHIELD developed more effective ways of processing and disseminating this crucial information to its users and thus improved the theater warning capabilities of DSP.



As these improvements were demonstrated by SHIELD, it became apparent that the usefulness of fusion and distribution capabilities far exceeded the original intent of theater warning. SHIELD had established a baseline capability from which sensors, Command and Control (C2) elements, and military forces could significantly improve their ability to prosecute all Ballistic Missile Defense (BMD) objectives, whether TMD or NMD.

III. MAXIMIZING INTEROPERABILITY OF EXISTING SENSORS: SHIELD NMD BMC3 APPLICATION

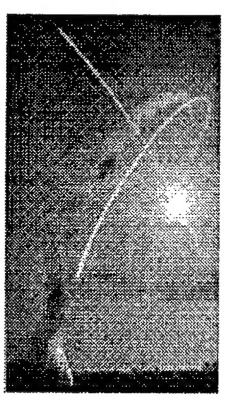
Although TMD capabilities have been the primary focus of the SHIELD development, experiments have proven the effectiveness and breadth of SHIELD capabilities in NMD applications. The objective of development in SHIELD Phase II has been to integrate as many differing technologies as possible to form a coherent situational picture, improving both the quality and quantity of information to the user. This effort, as applied to the BMD arena, results in the interoperability of sensors to produce a shrinking ellipse along the flight path of the missile, and ultimately results in a weapons accuracy cue. Initial results from sensor demonstrations indicate significant gains using existing capabilities, which can be applied directly to NMD BMC3. An initial look at some of the capabilities employed is provided below:

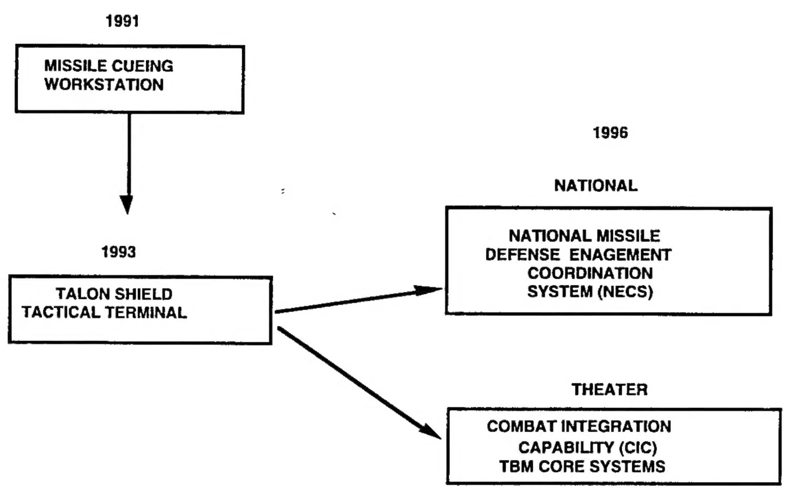
Initial Detection. The original TALON SHIELD system was designed to fuse multiple DSP satellites to improve reporting of theater class missiles. Developed by GENCORP/Aerojet, this system provides a baseline development capability for the entire United States Space Command (USSPACECOM) Theater Event System (TES) architecture, including the Army/Navy Joint Tactical Ground Station (JTAGS), the Tactical Detection and Reporting (TACDAR) system, and the 11th SWS.

It should be noted, however, that although the focus of TES elements is theater processing, the detection of strategic missiles has been a DSP mission for over 20 years. Profiling and past experience with these types of threat missiles is well tested, and incorporation into SHIELD processing capabilities can greatly enhance the ability to prosecute a strategic missile defense capability, providing value-added improvements to NMD BMC3 concepts. Using state of the art processing, fusion of multiple DSP satellites provides significant improvements in quantity and quality of data processed, accuracy and timeliness of outputs, and creates a three dimensional in-flight position for threatening missiles. This capability has been proven accurate and reliable and was operationally implemented for the theater by the 11th SWS of AFSPC on 10 March 1995, less than 3 years from the inception of its parent project TALON SHIELD. Integration of existing strategic missile database profiles for SHIELD fusion processes is well within reach for NMD application in a short time period. Launch detection and reporting of NMD targets of opportunity, as well as real threats, have been able to advantageously use these processing improvements.

In addition to DSP, SHIELD takes full advantage of its TENCAP heritage by integrating National Systems data into its processing. Inclusion of these sources provides significant improvements in capability.

Cueing and Hand-off. Prior to the first major SHIELD contract award, efforts were underway at AFSPC to develop a tool that would enhance a warfighter's ability to receive an off-board missile warning message, and use that information to determine search volumes and direct follow-on sensors and fire control systems. That tool migrated under the SHIELD umbrella early on, as the "Missile Cueing Workstation" development through Nichols Research Corporation (NRC), sponsored by AF TENCAP. This workstation was designed to take the outputs from DSP fusion and cue theater interceptor systems, providing not only situational awareness, but also a method of





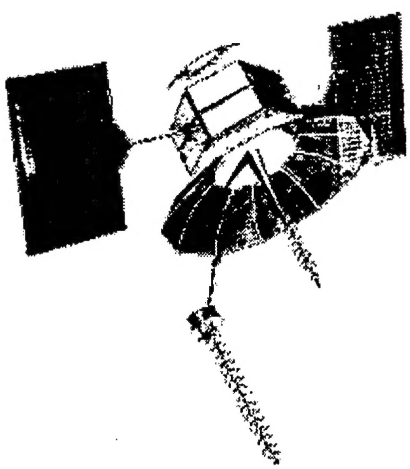
cooperative engagement among theater assets, sensor-to-sensor cueing, and propagation of a weapons accuracy cue to aid in battle management and weapons allocation in the theater. This system is currently deployed in ground and airborne systems to support theater exercise operations, known as the TALON SHIELD Tactical Terminal (TSTT). As the Air Force begins development of its Combat Information Center (CIC), the TSTT software and design figures prominently in its ability to meet near-term objectives.

NMD demonstrations have made judicious use of this mature capability, modified to support strategic events, and known as the NMD Engagement Coordination System (NECS). The NECS has been used to accomplish the same functions it was designed for in-theater, and is the fundamental cueing, data communication, and track propagation system for SHIELD NMD, using ITW/AA RADARs and surrogate anti-ballistic missile (ABM) intercept systems in place of theater systems. Experiments have been accomplished using the NECS to directly cue strategic RADARs such as PAVE PAWS (UHF), HAVE STARE (X-Band), and Millstone (L-Band), and to send In-Flight Target Updates (IFTUs) to surrogate interceptors such as the Airborne Surveillance Testbed (AST) optical sensors as well as forwarding cueing data to the Hardware-in-the-Loop (HWIL) Advanced Solid Axial Stage (ASAS) test facility at Edwards AFB. Multi-sensor automated fusion, cueing and hand-off, and multiple object correlation has been accomplished using these sensors, as well as others such as Cobra Judy, Aegis Spy-1, Haystack, AF Maui Optical System (AMOS) and multiple shipborne and airborne systems. The NECS provides potential for immediate NMD architectures, graphically depicting the radiation patterns of warning RADARs and accurately predicting when the RADAR will acquire based on cued and/or autonomous RADAR operations. When the RADAR detects, the NECS depicts in real-time the target state vectors reported, distinguishing between differing sensor inputs, as well as fusion results. In addition, the NECS provides solutions to interceptor fire control assets, showing in a real-time mode, a look-ahead of when intercepts can occur, how many shots are possible against the threat, and when those shots must be taken. This data can be made available in an automated format to directly cue fire control assets and interceptors and to direct a missile in-flight.

The NECS capability is of great value in promoting the interoperability of existing sensor systems. In addition to the capabilities described above, the NECS is integrated with several fusion algorithms which serve, not only to promote cooperative engagement among assets, but also to integrate the sensor capabilities with each other. This creates a single system with current ITW/AA assets which are currently processed individually in the National Military Command Center (NMCC), at Strategic Command (STRATCOM), and at the Cheyenne Mountain Operations Center (CMOC). Technically, these integrated capabilities are easily made available for NMD application in the short-term using existing assets.

Communications to and from the Sensor. During initial cueing experiments, SHIELD directly cued sensors and received data and messages back from sensors. Current cueing to ground based sensors uses STU-III capabilities for data transfer, although more capable and permanent lines are feasible in the short term. Communications to airborne and shipborne sensors leverage off of the theater methods already developed, broadcasting messages by Ultra-High Frequency (UHF) Satellite Communications (SATCOM) capabilities including: the Tactical Information Broadcast Service (TIBS), the Tactical Receive Equipment (TRE) and Related Applications (TRAP) Data Distribution System (TDDS), and other UHF

SATCOM. A capability to cue mobile assets is possible with a remote NECS terminal, which has the capability to directly receive TRE inputs for processing and automatic cueing to sensors. If an emergency response architecture for NMD calls for the participation of mobile assets, such as Aegis, Cobra Ball, Cobra Judy, or others, these capabilities can be readily applied. Interoperability of mobile assets, although challenging, is not unfamiliar territory, and has been demonstrated with theater assets on numerous occasions. Sensor to sensor cueing, cooperative engagement, and shared communications, translate to flexibility in shooting strategies and the ability to launch an interceptor more quickly, while the threat missile is over neutral territory.



Communications from sensors to SHIELD are also currently accomplished via STU-III, although more dedicated and reliable forms of communication have been operationally implemented in the past and are not challenging in the short term. Various message formats and protocols used by the RADARs are translated by the NECS into a format that is easily accepted by SHIELD's resident fusion capabilities. Data communications from airborne and shipborne assets are received via UHF SATCOM, decrypted, and their data fused with the other tracks available.

Sensor to Sensor Fusion. SHIELD hosts the most capable fusion algorithms in the world. Of particular interest to NMD are the algorithms which fuse satellite with satellite, satellite with RADAR, and RADAR with RADAR data, although there are other types of fusion capabilities resident in the facility.

The SHIELD Central Tactical Processing Element (CTPE) is an 'N'-Source fusion processor developed by GENCORP/Aerojet, taking data from sensors of differing technologies, and fusing it at the data level to form a coherent, single track. Experiments using MSTI, Cobra Ball, Cobra Judy, and classified sources have been conducted and have resulted in real-time fusion. Analysis has shown that in the majority of cases, significant gains are made in one or more parameters which determine the ability to early-commit an interceptor.

SHIELD also hosts the Data Fusion Tool (DFT) developed by Nichols Research Corporation (NRC), which has a correlation algorithm designed to identify lethal objects among detected RADAR observations. This midcourse track discrimination takes advantage of the satellite fusion provided by CTPE as well as processing which occurs at the RADAR. This algorithm is invaluable for determining which objects are lethal and for populating the message traffic which is ultimately forwarded to the interceptor. The DFT, combined with the CTPE, enables SHIELD to accurately fuse and correlate threatening missile detections from multiple sensors of differing technologies in the boost, initial ballistic, and midcourse phases of flight.

In addition to these primary fusion algorithms, SHIELD hosts Hughes' fusion algorithm for national and multi-source data. This capability has been resident in SHIELD for over a year. The code for this system has recently been downgraded to SECRET and has been initially used in the collection and analysis of data from NMD demonstration

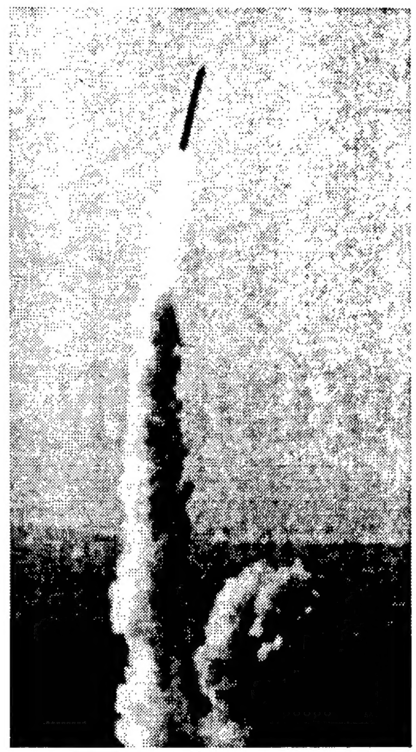
participants. The evaluation of the results from Hughes will determine which phases of flight can benefit most from their added capabilities.

Although not fully integrated into the SHIELD processing architecture, Wagner Associates have proposed the integration of their fusion algorithm, which, upon initial analysis, shows promise in the sensor fusion efforts that are on-going.

These fusers ultimately feed the NECS with the results of their on-line processing, refining multiple sensor inputs and sensor-to-sensor cues, and culminating in the generation of a weapons accuracy cue which is automatically generated from the NECS to terminal sensors and intercept systems.

Interceptor Cueing. Following the detection of launches and initial and subsequent cueing of RADARs, the ability to provide an accurate cue to interceptor assets during the midcourse and terminal phases of flight is also an area in which SHIELD provides a significant increase in capability. The accuracies gained by fusing multi-source data are proving to be sufficient for early launch and commit of interceptor assets. Although this capability can be leveraged by a multitude of interceptor systems, a down scaling of our strategic alert forces has recently resulted in the availability of the highly accurate MMIII for use as an interceptor for the defense of the CONUS, Hawaii, and Alaska. With the inclusion of a Kinetic Kill Vehicle (KKV) payload on the MMIII, an accurate intercept capability is available for NMD in the near-term, leveraging off of previous interceptor development efforts. Its in-place command and control (C2) structure can be quickly modified to provide rapid defensive response to incoming missiles.

Interceptor launch control interface with the SHIELD NECS provides real-time fire control, engagement coordination, determination of launch solutions, and a projection of interceptor shot opportunities. The NECS shows in real-time when shots must be taken, by which interceptor assets, in order to intercept incoming missiles. The capability exists to conduct engagement flyouts based on classified RADAR parameters, ballistic threat profiles, and interceptor capabilities and trajectories.



In-Flight Target Updates (IFTUs). Building on current capabilities, SHIELD has fused data from multiple sources, correlating tracks, identifying probable lethal objects, and providing IFTUs for interceptors in flight. Initial experiments with AST, Edwards, and Aegis proved SHIELD's ability to transmit IFTU messages for use by surrogate interceptors and test hardware. The demonstrations involved the slewing of the AST optical sensor for final accuracy measurement prior to target object mapping (TOM) and simulated final divert to kill. Using identified lethal objects from SHIELD, AST successfully acquired the target complex in-flight as a surrogate interceptor.

Target Object Mapping (TOM). Leveraging off of expertise in RADAR systems, NRC has developed a TOM algorithm which is currently resident on the Airborne Surveillance Testbed (AST). This TOM algorithm maps onboard sensor observations against the target complex provided by IFTUs transmitted from SHIELD enabling the surrogate interceptor to discriminate lethal objects from other pieces. Testing on-board the AST has provided outstanding insight into the TOM's projected performance on the interceptor for a cued final divert to kill capability.

Decision Making Architectures. Currently, decision-making in NMCC, STRATCOM, and the CMOC is accomplished by a system of voice reporting which has been in place and relatively unchanged for a significant period of time. Although the processing systems have changed somewhat, this voice architecture is easily adaptable to the new mission of NMD. New processing systems which are used for NMD do not necessarily have to be integrated into existing capabilities. It is possible to integrate NMD functionality without complex integration efforts, as has been shown by numerous systems which have aided in information processing and decision-making. In the CMOC Missile Warning Center (MWC) alone, non-integrated systems such as the Integrated Warning Capability (IWC), the Intelligence Data Handling System (IDHS), World-wide Origin and Threat System (WOTS), Theater Display Terminal (TDT), Subscriber Terminal (ST), Constant Source, and Standard Tactical Receive Equipment Display (S-TRED), and others have been used to supplement integrated systems so that an informational advantage in missile processing could be gained, or so that compatibility with other systems could be achieved.

Taking example from these non-integrated missile warning systems, it is very feasible to integrate a functional mission such as NMD, without integrating the processing systems with antiquity. A remote processing capability can take advantage in the exponential gains in information processing and feed the results very capably to decision-making locations using the modest gains that have also been made in communications. If inputs from several operational work centers are required for a decision to be made, Closed Circuit Television, and video distribution systems are more than able to handle this necessity.

Engagement planning, sensor tasking and weapons tasking can leverage remote displays to applicable Command Posts. A near-term NMD BMC3 operational architecture can be in any location, with data being fed to decision-makers remotely.

End-to-End Detection, Sensor Cueing, Fusion, Correlation, and Discrimination. The capabilities just described, with the exception of on-board and remote SHIELD systems, are all capabilities resident in the SHIELD facility. This provides an end-to-end NMD capability from a-priori tip-off, to threat missile launch, to final divert for intercept, and beyond, if debris detection, civil defense and BDA are included. SHIELD has proven technical capabilities, and a demonstrated migration path of highly capable systems to operations which demand to be exploited for a timely, operational NMD capability.

IV. MINIMIZING THE RISK: PROVING THE CONCEPT THROUGH DEMONSTRATIONS

Demonstration and Development Strategy. Since early developmental stages, SHIELD has been at the forefront of NMD BMC3. SHIELD is applying breakthrough computer processing technology gains to the NMD mission, and has developed or exploited the fundamental capabilities necessary for any BMC3 architecture: high rate data processing, multi-source sensor data/message fusion and correlation, data

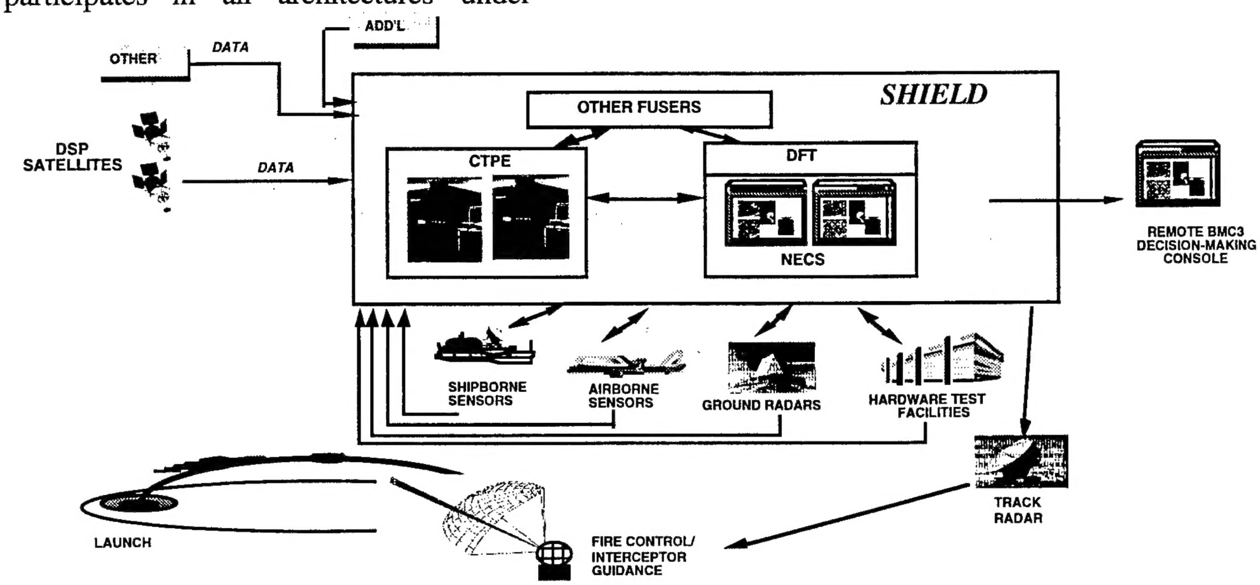
communications, sensor cueing, lethal object identification, target track propagation, and target discrimination for final divert to kill. SHIELD's philosophy for research and development has always followed the 4D principle: Design, Develop, Demonstrate, and Deliver. This philosophy involves a continual involvement with the military operator, and dictates that some development occur as a result of demonstration. The strategy for development through demonstration is to "test a little, learn a lot". This is currently being applied to NMD, and includes an incrementally complex series of experiments, culminating in an end-to-end demonstration of capability for the system.

The use of live operational events and live data is the preferred method of demonstration, so that it will resemble the actual performance of an objective system as closely as possible. Integrated demonstration is the preferred methodology, as all elements must work together in an operational system.

Synopsis of Major NMD Live Fire Demonstrations. SHIELD continues to be a key player in NMD live-fire demonstrations and exercises, and participates in all architectures under evaluation. During these demonstrations, SHIELD has established a legacy of "firsts" which are directly applicable to NMD. A synopsis of some major demonstrations and key players follows:

8 October 1993: White Sands Missile Range (WSMR). DSP data fusion. Messages based on fused DSP were sent from SHIELD to cue the Eldorado PAVE PAWS RADAR, which in turn cued the Multiple Object Tracking RADAR (MOTR) at WSMR. This RADAR then cued a patriot battery, which locked on to the target, and broke lock, determining that the target was within the error basket for cued acquisition.

30 August 1995. Peacekeeper, Vandenberg: DSP fusion. Messages from SHIELD were broadcast to COBRA JUDY. Judy acquired the object and sent Target State Vectors (TSVs) back at once per second over UHF SATCOM. This data was accepted and fused with DSP at SHIELD. SHIELD determined that Judy was tracking the wrong object and notified Judy. Judy dropped track and reacquired the target vehicle, emphasizing the benefits of fused data, over single source.



(U) SHIELD NMD BMC3 Demonstration Architecture

14 Nov 1995. Maxus, Norway: DSP fused data. Messages sent from SHIELD to cue the Fylingdales RADAR. Fylingdales acquired the object below their normal surveillance fence, underscoring the potential benefits of a cued search to gain track time on threatening missiles. Fylingdales data was transmitted back to SHIELD. This event also emphasized the advantages of the SHIELD processing system over the current strategic warning system, which did not perform exceptionally well.

6 March 1996 MMIII, Vandenberg: DSP data fusion. Messages based on DSP data sent from SHIELD to cue the Beale RADAR. Beale transmitted data back, which was fused with DSP. Sent cue to HAVE STARE. Fused DSP, Beale and limited HAVE STARE data, due to system crash closely following detection. AST cued. Received and processed AMOS data.

26 Jun 1996. Dual MMIII, Vandenberg: DSP data fusion. Messages based on DSP data sent from SHIELD to cue the Beale RADAR. Beale detected and transmitted data back, which was fused with DSP. The target complex was identified and the lethal object was selected automatically for a cue to HAVE STARE. HAVE STARE acquired based on the cue and sent data back to SHIELD. This data was fused and a new lethal object selected. The IFTU was populated with the target complex and used to cue AST to the target, which acquired the complex based on the cue. Launch ALERT Messages, Emergency Action Messages, and Force Direction Messages were generated for the REACT/SMIC at Hill AFB, Utah and also to the HWIL facility at Edwards. A remote BMC3 console was demonstrated at Hill AFB, populating and processing remotely off of sensor data, to prove the capability of BMC3 remote to Cheyenne Mountain, or other NMD decision-making nodes. Received and processed AMOS data. Simultaneously ran three fusion engines real-time in SHIELD.

Upcoming events: SHIELD stands ready to play a key role in any and all targets of opportunity as they arise, both through live-fire demonstrations and through the fielding of an emergency response system for NMD. Planned demonstration events include a continued exercising of emergency NMD capabilities on both coasts, and eventual cueing of live interceptor assets, not yet approved due to treaty implications.

NMD System Evolution & Follow-on Capabilities: As new sensors and systems are brought on-line, SHIELD's open architecture allows for easy integration of additional capabilities. SHIELD has a ready migration path for incorporation of new sensors and systems, such as SBIRS. Although these systems are too far in the future to be implemented in an emergency NMD system, their processing has been planned for integration into the current SHIELD system. The SHIELD/ALERT system is officially the AFSPC "SBIRS Pathfinder" and is the means by which gains in ground processing and fusion are applied directly to the new satellite constellations.

SHIELD cueing and fusion capabilities apply to any suite of sensor systems which is developed, and individual elements of NMD which reach maturity quickly can be incorporated into this emergency architecture.

MINIMIZING START-UP AND TRANSITION TIMES: A DEMONSTRATED PLAN OF ACTION

Key to minimizing start-up and transition times is having a clear plan of action. SHIELD's legacy includes a true team concept, with a well defined and practiced methodology for the transition of large systems to real-time operations in short order. This team integrates the acquisition community, the military user, and the development contractors into a cohesive organization, with a strong personal identification to the mission as

well as its successful, rapid operational implementation. The SHIELD team is still present in the majority, and able to transfer the same successful philosophy from ALERT to operations for NMD.

The plan of action employed by this team includes successful acquisition practices, a well-defined development goals through a clear concept of operations (CONOPS), and a method to transition proven capabilities to operations.

Acquisition Strategy: A Team Concept. Combined with SHIELD's technical legacy is its programmatic innovation, which, in a period of military downsizing, resulted in the creation of an Air Force squadron, and significant awards for acquisition reform for the System Program Office (SPO) at SMC. As learned in the SHIELD development, the "test a little, learn a lot" philosophy is consistent with DODD 5000.1, which states: "Technology demonstrations and aggressive prototyping... coupled with early operational assessments, are to be used to reduce risk". The acquisition of the ALERT/SHIELD capability has been based upon risk management through demonstration, rather than risk avoidance. SHIELD in its acquisition and operational transition has been fully consistent and compliant with the DODD 5000 series, and yet at the same time, revolutionary, being the single example of a major military system operationally fielded in short-time at minimal comparative cost.

SHIELD anticipates that the costs of standing up an operational NMD mission will closely parallel the development and transition to operations of TALON SHIELD. NMD BMC3 costs can be significantly lowered by exploiting this recent historical event, providing a very feasible short-term alternative to the long development timelines inherent in any other solution. SHIELD has historical cost and schedule figures representing the completed development and operational transition costs of such a system.

Concept of Operations.
Included in SHIELD's plan of action is the CONOPS, which guides te development of the system down an operational path. Besides defining the developmental direction, it also provides a plan from which military procedures can be developed, translating operational events to actions to be taken by the crew. The basic sensor/ BMC3 CONOPS as it relates to SHIELD is as follows:

- DSP and other sensors detect launch
- SHIELD CTPE collects and fuses data from DSP and others, initiates initial LP, in-flight vector and PI messages
- SHIELD CTPE transmits via operational message formats
- Remote BMC3 Node receives data, events are assessed for threat characteristics
- SHIELD NECS receives fused DSP and calculates uncertainty volume, look angles and probable location for missile to enter RADAR coverage
- SHIELD NECS generates the Launch ALERT Message (LAM) for Preparatory Launch Command (PLC-A)
- Based on world situation & policy, initial intercept authorization provided through Emergency Action Messages (EAMs)
- SHIELD NECS translates message format, cues RADAR
- SHIELD continually updates position and transmits to sensors and decision makers
- SHIELD NECS continues to recalculate position of entry into RADAR coverage, provides initial firing solution for interceptors
- RADAR passes data back to NECS, which reformats data and passes to RADAR fusion/correlation algorithms within SHIELD
- SHIELD fuses RADAR data with DSP providing quicker time of launch to target
- Authority to intercept provided based on operational events and defensive configuration

- Fused report is passed from SHIELD fusers to NECS
- NECS refines intercept solution, cues additional RADARs as applicable
- Once target location uncertainty volume is within maximum acceptable range for interceptor launch, NECS passes Force Direction Message (FDM) targeting solution to Launch Control Center
- LCC initiates target data load
- LCC launches interceptor
- Data is continually refined by SHIELD, from RADARs and other sensors, updated information is passed on to the LCC
- SHIELD passes refined intercept solution, generates IFTU, transmits to interceptor
- Interceptor acquires target compares TOM and begins final divert to intercept
- KKV intercepts payload
- SHIELD, RADARs detect intercept and provides initial kill assessment

The majority of elements in this CONOPS have been demonstrated, either with actual sensors, or surrogate sensors in NMD demonstrations over the last three years. The architecture has used existing assets, and has proven the feasibility of achieving a near-term emergency NMD system. Below are some of the participants, and the function they have demonstrated:

DSP Processing : SHIELD stereo and greater processing proven in NMD demonstrations since 1993. Routinely accomplished in 11th SWS operations.

DSP to RADAR Cue : First SHIELD cue to Eldorado in 1993. SHIELD DSP cues to RADARs also include Beale, Cape Cod, Fylingdales, Cobra Judy, Aegis Spy-1, TPS-75, TPS-59, SPS-48

SHIELD DSP Cue to other Military Assets: Shared Warning, Cobra Ball, AST, ARGUS/PRISM, Speckled Trout, USS Kidd, USS Eisenhower, USS Wasp, USS Anzio, USS Cape St George, Patriot (Ft Bliss), Cheyenne Mountain, Theater Air Operations Centers, military assets with UHF receive capabilities.

RADAR to RADAR Hand-off using SHIELD NECS: (UHF, X-Band, L-Band, S-Band), PAVE PAWS, MOTR, HAVE STARE, Millstone, Haystack

Fusion/Correlation of RADAR/ Sensor Data using SHIELD CTPE & DFT: Cobra Judy, Beale, Cape Cod, HAVE STARE, MSTI-2, MSTI-3, Cobra Ball, Cobra Brass, Other, Intel Sources

Automatic Selection of Lethal Object using SHIELD DFT: PAVE PAWS, HAVE STARE

Hand-off to Terminal Tracker using SHIELD CTPE: MOTR, Patriot, X-Band RADARs

Communications with Terminal Track/ Interceptor Fire Control from SHIELD: REACT/SMIC, Aegis Guided Missile Cruiser, Patriot

Interceptor Communications via SATCOM from SHIELD: Edwards AFB Hardware-in-the-Loop Facility, broadcast to AST as surrogate interceptor

SHIELD support of Decision Making Architectures: Remote BMC3 at Hill AFB, Utah

Transition to Operations.
With the wealth of knowledge and experience available at SHIELD and in ALERT to aid in the transition to operations, this is by far the least problematic milestone of all. Transition to operations is a continual process, as the military user is continually involved in the development of Space Warfare Center systems. Once an authoritative decision is made to go operational, the military organization charged with that responsibility provides the logistical support necessary to make it happen. In the case of the SHIELD/ ALERT transition, the squadron was activated on

30 Sept 1994, and certified as operational on 10 March 1995, for approximately a six month transition. This being the first departure of a DSP operation from the ITW/AA structure, it was meticulously measured prior to operations being declared.

The strategy of a near-term NMD acquisition is to produce a capable system which leverages off of current systems and capabilities, to integrate and test these capabilities, and to field them as quickly as possible to provide a missile defense for the United States. Using the successful strategies employed at SHIELD, the ability to guard against the first nuclear weapon landing on American soil is well within reach.